Site identification	Pre-scoping discussion	Scoping call	Activity Determination	EPR ARA Management Oversight	Contingency, Notification, Emergency Action Plan	Date Consultation Package Complete	Consultation Package Started	Consultation Process Complete	Field Start Date
This year (2017)									
GKM Phase2 (Flow Control Structure & Horizontal Drain Borehole	11 April	n/a	Activity is categorized as **2-H**; and TetraTech reviewed last year's package favorably	Briefing held 19 April	Using original Plan	2 June	5 June		10 July
Bonita Peak - - American Tunnel investigation borehole	11 April	TBD	Activity was originally categorized as **2-H**; however, Removal Assessment is reconsidering downgrading the potential for fluid hazard due to experience with previous borehole						7 Aug
Bonita Peak – American Tunnel Bulkhead #3 Access		See attached **2-N** determination memo[1]	Activity being planned as **2-N** in support of Assessment for R&B Bulkhead Valve Closure Plan						10 July

[1] Draft final fluid hazard category determination Memo-American Tunnel #3 Bulkhead

Site identification	Pre-scoping discussion	Scoping call	Activity Determination	EPR ARA Management Oversight	Contingency, Notification, Emergency Action Plan	Date Consultation Package Complete	Consultation Package Started	Consultation Process Complete	Field Start Date
Libby Asbestos-OU3, MT	TBD								
Carpenter Snow Creek, MT	TBD								
Barker-Hughesville, Block P Mine Complex, MT	31 May	See attached **2-N** determination memo[2]	Activity being planned as **2-N** after review of PRP's AOC work plan						10 July
Upper Tenmile Creek, Susie Adit drain pipe, MT	24 April	TBD	Activity considered **2-H** after noting Susie Adit is connected to Upper Valley Forge Mine						
Flat Creek IMM, MT	TBD								

[2] Draft final 31 May fluid hazard category determination memo requires 8MO concurrence

Ref: EPR-ER

MEMORANDUM

SUBJECT: Mine Site Category Determination for Fiscal Year 2017 Planned Activities

Removal Assessment of American Tunnel Bulkhead #3, Bonita Peak Mining District NPL Site

FROM: Paul Peronard, OSC; Kerry Guy, OSC; Rob Parker, RPM, Ian Bowen, Hydrogeologist James Hanley, regional mining coordinator

THRU: Laura Williams, Dave Ostrander, Stan Christensen, Bill Murray

TO: Sandy Stavnes, Betsy Smidinger, BPMD Site File

This memorandum is written to the file as documentation of the Mine Site Category activity determination required by the EPA OLEM memorandum (James Woolford/Reggie Cheatham, 4 April 2017).

Conceptual Site Model

The concept of the overall nature of groundwater and mine water interaction continues to evolve as integrated project delivery teams plan and complete removal assessments and remedial investigations of the predominant features controlling groundwater flow regimes and the resulting risks at this NPL Site. Four projects have been planned, and in some cases, already implemented, to understand the Site hydrogeologic characterization of the Cement Creek Basin portion of the Site. Activities at Gold King Mine, Red & Bonita, the Mogul/Grand Mogul Mines, and the American Tunnel are ongoing to characterize their relationships to the Sunnyside Mine pool of impounded water. The scope of this memo is limited to planned activities within the American Tunnel from its portal to a distance of 375 feet where Bulkhead #3 can be reached.

Geology in the upper Cement Creek area is in the Silverton Caldera, part of the San Juan volcanic field. The Gold King, Red and Bonita, and American Tunnel are all in the Burns member of the Silverton Volcanic sequence. The Burns member consists mostly of latitic tuffs and intermediate lava flows made of porphyritic dacite, rhyodacite, rhyolite, andesite, and trachyandesite. These rocks are frequently hydrothermally altered to a much weaker propylitic mineral assemblage. The lower North Fork of Cement Creek below the Gold King Mine is entirely within fractured latitic tuff of the lower Burns member. The stiffness of the tuffs has resulted in a widespread, systematic fracture pattern in the rock mass, especially near the surface. The fractures are generally tight, closely spaced and persistent. They generally become tighter and more widely spaced with depth where only the master joints and other large discontinuities contribute to the rock mass properties.

Bulkheads. Multiple bulkheads have been installed in the District beginning in 1994. Four structures on the F and B Levels in the Sunnyside Mine isolate the mine pool from the Brenneman and Mogul Mines. Besides the three-bulkhead system in the American Tunnel (1996-2002), the Terry Tunnel has two bulkheads isolating the Sunnyside Mine from the upper Eureka Creek drainage. The Mogul Mine bulkhead was installed in 2003. EPA constructed a bulkhead in the Red & Bonita Adit in 2015 but has not closed its valve pending evaluation of the predicted effects of storing MIW behind this bulkhead.

Piezometers. A vertical piezometer (NFCCPZ-1) was installed in the fracture zone along the North Fork of Cement Creek just below the Gold King tailings pile in late 2016 to understand the hydrogeology of the North Fork fracture zone and its hydraulic connection to the American Tunnel. Another vertical piezometer is planned to be deep and accurate enough to intercept the American Tunnel somewhere between Bulkheads #2 and #3. This planned activity is the subject of a separate consultation package.

3-Dimensional Digital Model. Autodesk Civil 3D and earthVision software have been used to visualize this complex physical world of interconnected mine openings and regional geologic faults. The digital model incorporates the orientations of dominant faults, and all the existing mine workings using the USGS National Elevation Dataset digital elevation model for the surface topography. The elevations of the bulkheads installed in each mine are represented, along with the elevations of the seeps and springs database. Data describing known hydraulic pressures, including seep elevations, measured bulkhead pressures, porewater pressures from piezometers, and historic mine pool estimates can be stored in this spatial model for trend analysis and to support hypothesis testing and evaluation of alternative courses of action.

Observations from the proposed American Tunnel bulkhead #3 inspection activity will be used to analyze data obtained from currently completed or planned removal assessment studies:

- Future piezometer installation to be completed behind American Tunnel bulkhead #3
- Recently installed Mogul Mine bulkhead pressure gauge
- NFCCPZ-1 piezometer installed near the fault zone at the GKM Level 7 waste rock pile.

Physical Setting.

Some of the most critical mining structures in the BPMD NPL Site area are the three bulkheads in the American Tunnel. Bulkhead #1 was designed to control the Sunnyside Mine pool. Bulkhead #2 was designed to control inflow from the wet fracture zone or hinge fault that manifests itself as the North Fork of Cement Creek on the surface. Bulkhead #3 was designed to impound minor flows within the first section of the tunnel. The three bulkheads work together to form a supportive system reducing the pressure gradient and controlling the release of impounded water to manageable flowrates. The cause of EPA concern with the system is the relative uncertainty associated with the information in the as-built bulkhead construction and maintenance records and the current inability to directly inspect the mechanical integrity of these important underground concrete structures.

According to EPA technical consultants, the most likely failure mode of a bulkhead is seepage and piping. Piping is the undesired development of water flowpaths around the bulkhead due to the displacement of small soil and rock particles transported by erosive water velocity. Piping starts small but can increase the size of the natural fracture patterns resulting in excessive seepage. Excessive seepage past a bulkhead occurs when the higher upstream pressure finds fractures in the downstream rock mass or concrete-rock interface that bypasses the bulkhead. The worst case would be where the pressure gradient and seepage is high enough to wash out material in joints, leading to a significant piping failure. Seepage and piping is a direct function of the pressure gradient across the bulkhead.

For Bulkhead 3, the construction certification report states that ... *the construction pipe was permanently closed on December 3 2002 and additional formation grouting was done downstream of the bulkhead for the remainder of the week. Very little grout was accepted [injected] during this process.*" The report does not provide technical information regarding grout locations, drill hole depths, quantities, and effectiveness in reducing flows. The report also does not state whether geologic formation grouting was carried out to close visible joints, stop dripping water, or conducted until grout could no longer be pumped into the surrounding rockmass. EPA technical consultants do not have sufficient information to make any further evaluation of mechanical integrity. Sunny Side Gold report (2003b) states "*The portal was closed but because of seepage downstream of the American Tunnel, the No. 3 Bulkhead was reopened to determine if Sunnyside could provide assistance to Gold King in reducing the seepage...*". What additional rehabilitation work on Bulkhead #3 that may have been carried out is unknown. This uncertainty regarding the mechanical integrity of the bulkhead could be reduced if the downstream side of the bulkhead and adjacent tunnel conditions could be visually

inspected. Unfortunately, the American Tunnel has been backfilled with uncompacted, blasted rock material from the portal for 375 feet to the face of Bulkhead #3 restricting direct access.

Flow measurements at the American Tunnel portal have averaged around 110 gpm since 2005 with no significant trends up or down from 2005-2016. The source of this water is not known. A line of evidence supporting the ongoing integrity of bulkhead #3 is that the flows have remained relatively steady despite the increasing amounts of infiltration and snow melt and the increasing flows from other adits at the BPMD Site.

EPA technical consultants report that the American Tunnel bulkheads are unlikely to fail in a catastrophic manner. If water pressures increase more than expected, the most likely consequence would be increased seepage past the bulkheads and through the rock mass. This increased seepage would express itself as increased drainage from the American Tunnel portal. Loss of mechanical integrity in the American Tunnel Bulkhead #3 presents a considerable source of fluid hazard and a significant consequence of failure for the three-bulkhead system. The most plausible failure mode would be rapidly-increasing seepage or piping past the bulkhead, possibly through joints or shears in the rock mass, resulting in uncontrolled releases at the portal.

The uncertainty associated with evaluating the true risk can be addressed by establishing access to the Bulkhead #3 from the portal and conducting visual inspections with remote-controlled cameras, and later by professional engineers making direct observations and mechanical tests of the bulkhead integrity.

Adit Flow monitoring. Flow measurements from Red & Bonita are not yet available in 2017, however the flow from Gold King has dropped slightly after peaking in September 2016. Steadily increasing flows strongly suggest a rising groundwater elevation inside the mountain draining the Red & Bonita and the Gold King Mines. This trend is possibly in response to a lagged groundwater recharge response after a return to higher and more normal levels of precipitation following the drought cycle from 2010-2013.

Planned Activities in 2017

Routine underground construction activities will be taken in the American Tunnel sufficient to examine the condition of an internal drainage culvert with remote-controlled cameras. Blasted rock fill will be removed from the portal to Bulkhead #3 (375 feet) with roof support installed as needed for safe passage. The condition of the bulkhead and tunnel conditions immediately in front of the bulkhead will be closely evaluated and then monitored on an annual basis.

Water in mine tunnels can be released via piping that bypasses existing bulkheads, temporary flow structures, cofferdams, or unintentional tunnel roof collapses during rehabilitation. Bulkheads stop or limit the flow of water from a mine tunnel and act as an underground dam with all the similar hazards that exist for these as for surface dams. However, the work to be performed during 2017 is intended only to provide visual examination of the mechanical integrity of Bulkhead #3 and its immediate supporting rockmass structure.

If flows surge during this examination (beyond the current steady-state rate of 110 gpm), higher drainage rates could overwhelm the construction dewatering system and spill from the American Tunnel portal. Sufficient additional treatment capacity at the Gladstone Industrial Water Treatment Plant (IWTP) is available to process excess flow that might develop during the American Tunnel backfill clearance operation. The IWTP at Gladstone was designed and is operated by Alexco Environmental Group; the plant is designed to currently operate at 500-600 gpm with peak flows up to 1,200 gpm. An expedient water conveyance ditch will be excavated prior to reopening the American Tunnel and operated to transfer excessive drainage emanating from the portal to the Gladstone IWTP.

The memorandum provides sufficient lines of evidence to warrant a "2-N" (Low fluid release risk-Nonhazardous consequence) for this removal assessment of a leaky bulkhead in the American Tunnel planned for summer 2017. Consultation with OLEM is not required prior to initiating the planned activities for 2017.

	Category N (No EPA actions that would increase fluid hazard)	**Category H** (Fluid Hazards impacted by EPA actions)
Category 1 Sites with no known water in the mine, or sites containing fluids with no or low fluid hazard	Gilt Edge, Milltown Reservoir Sediments, ACM Smelter and Refinery, Anaconda Aluminum Columbia Falls, Anaconda Smelter, East Helena, Libby, Mouat Industries	
Category 2 Fluids exist but fluid hazard is not sufficiently characterized or is unknown	**Bonita Peak: American Tunnel Bulkhead #3 Inspection**; North Fork Cement Creek Piezometer-1 installation (completed); Mogul Mine bulkhead pressure transducer (completed) California Gulch, Captain Jack, Central City, Eagle, Standard, Summitville, Barker-Hughesville Block P Complex, Basin, Carpenter-Snow Creek, Silver Bow Creek /Butte,	American Tunnel interceptor borehole, Nelson Tunnel, Upper Tenmile
Category 3 Sites that have a known or probable fluid hazard		GKM Level 7 Phase II; Flat Creek IMM

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May 31, 2017 (*still draft as of this date*)

Ref: *8MO*

MEMORANDUM

SUBJECT: Mine Site Category Determination for Fiscal Year 2017 Planned Activities, Barker-Hughesville NPL Site, Block P Mining Complex, Judith Basin and Cascade Counties, Montana

FROM: Roger Hoogerheide, Remedial Project Manager

THRU: Joe Vranka, Unit Chief

TO: The Barker-Hughesville Project Site File

This memorandum is written to the file as documentation of the Mine Site Category determination required by the EPA Headquarters' memorandum (James Woolford/Reggie Cheatham, 4 April 2017).

Site History

The Block P Mine Complex (the Site) is located within Judith Basin County approximately 55 miles southeast of Great Falls, Montana. The Site is located approximately 1.5 miles north of the Block P Mill Tailings Site within the Galena Creek watershed. Mining activities in the project area date back to 1879, when the first discovery of silver and lead ores was made. Near-surface ores were depleted by 1883. Mining activities in the area fluctuated between boom and bust cycles for the rest of the 19th century and for the first two decades of the 20th century due to unreliable transportation networks and fluctuating commodity prices. In 1927, the Block P properties were purchased by the St. Joseph Lead Company (whose successor is Doe Run Resources). The onset of the Great Depression forced the mine to close operations in 1930. The mine was briefly operated from 1941 to 1943, but closed once again at the order of the War Production Board. Minimal mining and exploration has occurred since the 1940s.

Physical Setting

The Site is located on patented mining claims within the Helena-Lewis and Clark National Forest, and elevations range from approximately 5,500 ft. to more than 6,000 ft. above mean sea level (AMSL). Galena Creek is the major stream that traverses the mineralized ore body and originates upstream of the project area and flows from north to south through the Site. In general, the mining features attributable to the Block P Mine Complex are located west of Galena Creek. In addition, there are numerous other historical mining properties and features present within the Galena Creek watershed. These other mining properties and features have been the focus of recent investigations by EPA.

Commented [RV1]: If you use AMSL here, it will correspond to the 1948 Block P Mine cross section that AMEC discussed during the pre-scoping conference call.

The Site used to contain several discrete waste rock piles and their associated mine workings that were addressed as part of a responsible party lead removal action conducted by Doe Run Resources between 2011 and 2013. Prior to the removal action, the Block P Mine consisted of a large waste rock pile containing about 200,000 cubic yards, mining-era buildings, and an uncontrolled mine adit at the 75 foot level (5910 feet elevation AMSL) that discharged to Galena Creek. The discharge coming from the Block P Mine flows year round with seasonal fluctuations in flows.

The Grey Eagle Mine is located on the east side of Galena Creek, across the valley from the 75 foot level. Depending on factors such as the time of year and overall precipitation patterns in the watershed, acid mine drainage from the Grey Eagle mine either discharges to Galena Creek via a constructed ditch or infiltrates into the ground at the mouth of the adit before reaching the creek.

In May 2011, the EPA issued Doe Run Resources an Administrative Order on Consent, requiring the implementation of a removal action at the Block P Mining Complex consistent with the Action Memorandum. Removal actions included excavation of mine wastes and consolidation of those materials into a repository located on property acquired by Doe Run. Under EPA and Montana DEQ oversight, an estimated 305,600 cubic yards of waste rock was excavated from the individual mines in the Block P Complex. The Galena Creek channel was also reconstructed and new culverts were installed at the up- and down-stream ends to facilitate passage of future flood flows and aquatic species. The culvert at the upper end of the corridor and the channel immediately downstream of this new culvert were aligned to carry flow slightly to the west of where the original channel was located to reduce the possibility that future high flow events would contact potentially-impacted soils that extend outside the project area. The resulting actions resulted in the draining of the underground workings from the 75 foot level to creek level in 2012. Historic underground working maps and a geophysical survey conducted in 2016 indicate the presence of underground workings at the toe of the former waste rock pile and underneath Galena Creek. Given the proximity of these workings to the surface, three uncontrolled seeps discharge directly into Galena Creek. The overall conclusion from this paragraph is that current equilibrium water table elevation in Block P Mine complex is 5910 feet AMSL which results in < 75 gallons per minute discharge into Galena Creek at high flow and < 50 gpm during base flow conditions. Therefore, the Block P Mine Complex is a Category 2 probable fluid hazard Site, as determined using Table 1 in Attachment 1 of the applicable memo cited above.

Planned Activities in 2017

The planned site activities for 2017 at the Block P Mining Complex are intended to reduce uncontrolled releases to Galena Creek and include the following:

1. Measure flows from each of the seeps adjacent to the stream at the Site.
2. Temporarily put Galena Creek in a pipe starting at the culvert crossing the road upstream of the Site and extending approximately 500 ft. downstream.
3. Build an earthen access road on the west side of the stream starting at the culvert and extending downstream approximately 200 ft.
4. Observe and measure flow from each of the three seeps at and near the Site for a 2-week period
5. Grout the 3 seeps with concrete, bentonite or a polyurethane resin such as Avanti AV-202-LV and Oakum as manufactured by Avanti International or equivalent from the surface of each seep.
6. Monitor grouting from surface for a period of two weeks and if not successful, pressure grout seep areas and monitor again
7. Construct a new stream channel east of existing channel.
8. Haul and add fill to the toe of the slope, approximately 5000 CY from nearby borrow source. This soil may be amended with bentonite to reduce its permeability
9. Topsoil and reseed new slope toe
10. Stabilize the Gray Eagle and 75 level Block P Portals by installing new timbers and putting new

Commented [MJ2]: You may want to describe that the way the 1945 Block P mine cross section does, as 75 Level, it will be understood that the unit are in feet and this will also conform to 20th century mining terminology that is still understood today.

Commented [MJ3]: Show the actual topographic elevation of this mine adit level to improve the general understanding of the current fluid level rending in the mining complex

Commented [MJ4]: If you have sufficient data for your CSM, can you describe the range of measured or estimated flows draining from the 75 level into Galena Creek?

Commented [MJ5]: Comment as above for consistent terminology.

Commented [MJ6]: Consistent Terminology

Commented [MJ7]: I need help here in my understanding of the situation. The 1945 Block P Mine cross section you provided in the conference seems to indicate that Galena Creek level is approximately 5410 feet elevation or only slightly lower than the 75-Level floor elevation. Is my understanding correct?

Commented [MJ8]: Is the surface expression of these seeps above or below the 75-Level? Does your level of confidence in the CSM allow you to conclude that the source of these seeps is the equilibrium surface of the water table created in the Mine Complex? If so, this will help you conclude that a seep interception grouting program will not disturb the equilibrium water level and result in new discharges in other uncontrolled locations.

Commented [MJ9]: Step 5 could be improved with AFW's help to describe the goals of this grouting program. Without getting into technical detail, step 5 should describe the concept of sealing the seep flowpath with the most effective grout material at a pump pressure low enough to avoid creating additional fracture flowpaths. The types of potential grouting materials, i.e. cement, bentonite slurry, or polyurethane resins is probably not that important for this memo.

Commented [MJ10]: The important point in Step 6 is that this will be a monitored grouting operation with sufficient technical oversight and control of grout pressures and grout material placement to avoid unintended consequences. The grouting operation can be curtailed if its effects on the seeps are not desired and make the releases worse.

Commented [MJ11]: Can AFW show you their geotechnical stability analysis of how the 5000 cy surcharge or additional overburden weight on the toe of the slope will reduce the seepage and redirect the water in a more desirable direction? The answer to this question, if available, is not necessary for this memo.

locking gates on each portal.

The primary objective of the above activities is to strengthen the slope toe adjacent to the Block P underground working near the surface so that stream erosion cannot compromise the stability of the workings. Secondary objectives are to reduce the volume of water seeping from existing workings, and prevent oxidation of any minor discharges to Galena Creek that were exposed due to the removal action. Prior to removal action, there was mine waste covering the toe of the slope and stability was less of a concern. In addition, the waste rock that previously covered the slope toe caused mine impacted water to discharge from the 75 foot adit and not from seeps adjacent to the stream. If this condition can be recreated, the adit discharge may be addressed in the construction season of 2018, including potentially installing a bulkhead in the adits. In addition to moving the stream away from the near surface mine workings, re-timbering the adits and installing new locking gates will make the area safer from potential trespass. These gates will not cause any hydraulic changes and have little potential to change the fluid hazard represented by the static water level just below the 75-foot level tunnel. Therefore, the Block P Mine activities that will occur in 2017 would be considered a Sub-Category "N" (Non-Hazardous) where the EPA Region 8 Montana Office will oversee activities that are not likely to increase the fluid hazard as described in Table 1. However, any bulkheading of the Grey Eagle and Block P Mine that is contemplated in 2018 will require additional consultation with OLEM prior to commencement of work.

Commented [KU12]: Consistent terminology

Due to the "2N" sub-category determination for this phase of Block P Mine work, consultation with OLEM is not required prior to initiating the planned activities for 2017.